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Met - 25 July 2013 w/ Rue Ann, Gary, Steve & Patrik (Jan & Rene) Received copy of URSUS qualifications.

June 28, 2013

Project No. 3-61M-125611

United States EPA, Region 10
1200 Sixth Avenue, Suite 900
Seattle, WA 98101

Attention: Ms. Jan Palumbo (AWT-121)

Subject: Source Area Investigation and Chemical Oxidation Pilot Test Work Plan J.H. Baxter & Co, Arlington Washington Facility

Dear Ms Palumbo:

On behalf of J.H. Baxter & Co. (Baxter), AMEC Environment & Infrastructure, Inc. (AMEC) has prepared this Source Area Investigation and Pilot Test Work Plan (Work Plan) for the wood treating facility located at 6520 188th Street NE in Arlington, Washington (Facility) (Figure 1). Recent studies at the facility have been conducted pursuant to the Administrative Order on Consent (AOC) dated April 30, 2001.

FILE COPY

This Work Plan addresses the need for additional characterization data and pilot testing to support in situ chemical oxidation (ISCO) as a potential technology, as described in the Corrective Measures Study (CMS), Revision 3, submitted to United States Environmental Protection Agency (EPA) on April 17, 2013 (AMEC, 2013), and in accordance with the U.S. Environmental Protection Agency's (EPA's) request for an investigation and chemical oxidation pilot test dated May 17, 2013.

In preparing this Work Plan, it has been assumed that public notice and public participation will not be required since the Work Plan addresses supplemental data acquisition and a pilot study to assess the selected remedial technologies and is not a plan to complete a final remedial action. All activities associated with this Work Plan will be implemented in accordance with the notification requirements of the AOC.

PURPOSE AND OBJECTIVES

The purpose of this Work Plan is to document the investigation tasks to acquire Facility-specific data to aid in the design and implementation of a chemical oxidation pilot study. The objectives of the investigation tasks are to collect sufficient data to design a pilot test that will evaluate the effectiveness of chemical oxidation as a remedial technology in the Main Treating Area (Figure 2).

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The results of this study will be used to support design and implementation of the final corrective measures to be implemented at the Facility. The pilot study, which will be further developed following the collection and evaluation of Facility-specific and bench test data, will be performed within the Main Treatment area and designed to address chemicals of concern (COC) as identified in the CMS.

BACKGROUND AND APPROACH

The Facility is currently operated by Stella-Jones Corporation, and uses pentachlorophenol (PCP) as the primary wood treatment chemical. Numerous investigations and remedial activities have been completed at the facility since the 1990s. Comprehensive background information regarding the Facility's history and the nature and extent of COCs in soil and groundwater are presented in the 2005 Site Investigation (SI) Report (Baxter, 2005) and the CMS (AMEC, 2013).

The SI and earlier investigations conducted in the 1990's identified both residual nonaqueous phase liquids (NAPL) and mobile NAPL in the Main Treating Area (Figure 2) that contributes to a PCP groundwater plume extending off-site. Several technologies were presented in the CMS (Baxter, 2013) to reduce COC concentration and mass in the areas of residual and mobile NAPL in the Main Treating Area ("source areas"). Chemical oxidation was selected in the CMS as a component of the preferred alternative, pending the collection of additional facility-specific data and pilot testing.

To conduct a chemical oxidation pilot test to assess the effectiveness of the technology at the Facility, we have developed a series of tasks to aid in the selection and design of the pilot test. The tasks are designed to build on the data generated by previous tasks. The proposed tasks include the following:

- **Task 1 - Collect Source Area Soil Data.** Collect additional soil data from the NAPL-affected source area by advancing four boreholes and collection of up to six representative soil samples for laboratory analysis. The boreholes will provide additional data within the source area to characterize geology, assess vertical COC distribution, and to provide material for bench studies.
- **Task 2 - Collect Source Area Groundwater Data.** Collect additional groundwater data from existing wells in and near the source areas to determine the chemical, geochemical and biological parameters and the likelihood/potential for the use of monitored natural attenuation (MNA) or biological amendment to support plume degradation. Additional groundwater from these wells will be collected for bench studies.
- **Task 3 - Bench Testing of Source Area Soil.** Conduct bench testing of soil and groundwater material from the source areas to assess selection of oxidants and determine oxidant demand.
- **Task 4 - Evaluation of Bench Scale Data and Design of Pilot Test.** Compile and evaluate data from the supplemental soil and groundwater sampling in the source areas, as well as the bench tests. Information summarized in this evaluation will be used to design the pilot test to

be implemented at the Facility. A report will be prepared for EPA's review and comment prior to initiating the pilot test. The report will include a tabular summary of data generated in Tasks 1, 2, and 3, the proposed design of the pilot test, plans for monitoring the effectiveness of the pilot test, and a schedule for completion of the pilot test.

- **Task 5 - Implementation and Evaluation of the Pilot Test.** This task will include the implementation of the pilot test as defined under Task 4. The specific nature and design of the pilot test will be developed following completion of Tasks 1 through Task 4.

All work will be completed in accordance with industry standard practices. Drilling, sampling, and laboratory analysis activities for both soil and groundwater will be conducted in accordance with the existing Sampling Analysis Data Management Plan (SADMP) included as part of the 2002 Site Investigation Work Plan, Revision 2 (Baxter, 2002). The soil, groundwater, and bench testing data generated during implementation of this Work Plan will not be used as part of the existing groundwater monitoring program, and therefore will not require validation or quality assurance reporting as specified in the SADMP. All field activities will be conducting in accordance with a Facility-specific Health and Safety Plan.

The following sections outline the elements of each of the five separate tasks.

TASK 1 - SOIL BORINGS IN SOURCE AREA

Four borings are proposed within the source area (Figure 3). The borings would extend to below the depth of residual NAPL, or approximately 40 feet below ground surface (bgs). The locations of the borings represent the areas with the greatest known extent of residual and mobile NAPL. Each boring would be advanced using rotosonic drilling technology to maximize soil recovery. A soil core would be retrieved from the entire length of each boring. The soil core would be carefully inspected by a geologist for soil types, lithology, obvious signs of contamination (using visual, olfactory, and vapor monitoring methods), presence/absence of water or NAPL, and presence of debris or non-soil matter. Representative grab samples would be obtained from the soil borings and retained for laboratory analysis and bench testing. Soil cuttings not used for testing purposes will be containerized into United Nations (U.N) approved drums, properly labeled, and stored at the facility pending disposal determination.

more detail on logic of boring locations flow diagram

Soil samples for chemical and geochemical analysis would be collected from selected representative depths in each boring. Up to six samples will be analyzed from the four boreholes; the depth intervals will be determined in the field by the geologist to provide representative coverage of different lithologies and anticipated COC concentrations for bench testing. Based on field observations, composite samples may be determined in the field to be more appropriate than discrete samples. In addition, selected samples may be collected and analyzed for specific parameters at different depth intervals to provide specialized data (i.e., soil oxidant demand for clean or woody intervals). A summary of the planned soil analyses is presented in Table 1.

Table 1: Analysis Plan for Soils

Parameter	Method	Data Use
Chlorophenols	EPA 8151M or 8270	COC
Petroleum Hydrocarbons	NWTPH-Dx	COC
Total Porosity	ASTM D425M	Geology/Hydrogeology
Grain Size	ASTM D422	Geology/Hydrogeology
pH	SM 4500	Geochemistry
Nitrate/Nitrite	EPA 300 Series	Geochemistry
Sulfate	EPA 300 Series	Geochemistry
Total Alkalinity	EPA 300 Series	Geochemistry
Chloride	SM 4500-CL	Product of COC degradation
Manganese/Iron	EPA 6010B	Geochemistry
Soil oxidant demand	EPA PSOD ASTM D7262-10	Geochemistry
Total Organic Carbon	EPA 415.1	Bioremediation Nutrient
Ammonia as Nitrogen	EPA 300 Series	Bioremediation Nutrient
Orthophosphate as Phosphorus	SM 4500	Bioremediation Nutrient
Diesel Degrading Bacteria	2002 Man. of Env. Microbiol.Chapter 84: Gasoline Degrading Bacteria (or equivalent)	Bioremediation Potential
CENSUS DNA Analysis - Aerobes/Anaerobes	Microbial Insights	Bioremediation Potential

TASK 2 - GROUNDWATER MONITORING IN SOURCE AREA

In addition to collection of soil samples for analytical and bench testing, five existing Facility wells will be sampled for analysis of a variety of chemical, geochemical and biological parameters (Table 2). The well locations were selected to obtain data from within the source area, as well as at downgradient locations to provide information regarding the geochemical changes in groundwater quality as the plume migrates. The analysis results will inform the use of MNA or bioremediation in the treatment of the contaminant plume. All sample collection and laboratory analysis will be conducted in accordance with the SADMP using submersible pumps and the appropriate water quality monitoring equipment. Purge water from the sampling activities will be containerized, and recycled in the existing remediation system.

Groundwater sampling will occur at five locations (Figures 2 and 3) as follows:

- MW-11 (upgradient well)
- MW-12 (source area well)
- MW-32 (near source area well)
- MW-36 (mid-plume well)
- MW-41 (downgradient plume well)

Table 2: Analysis Plan for Groundwater Characterization

Parameter	Method	Data Use
Chlorophenols	EPA 8151M or 8270	COC
Petroleum Hydrocarbons	NWTPH-Dx	COC
Oxidation Reduction Potential	Field	Geochemistry
pH	Field	Geochemistry
Specific Conductivity	Field	Geochemistry
Dissolved Oxygen	Field	Geochemistry
Nitrate/Nitrite	EPA 300 Series	Geochemistry
Total Iron	EPA 6010B	Geochemistry
Ferrous Iron	Field	Geochemistry
Manganese	EPA 6020	Geochemistry
Sulfate	EPA 300 Series	Geochemistry
Sulfide	EPA 300 Series	Geochemistry
Total Alkalinity	EPA 300 Series	Geochemistry
Methane	RSK Method 175	Geochemistry
Divalent cations (Ca, Mg, Al)	EPA 6000 Series	Geochemistry
Chloride	SM 4500-CL	Product of COC degradation
Total Organic Carbon	EPA 415.1	Bioremediation Nutrient
Ammonia as Nitrogen	EPA 300 Series	Bioremediation Nutrient
Orthophosphate as Phosphorus	EPA 300 Series	Bioremediation Nutrient
Diesel Degrading Bacteria	2002 Man. of Env. Microbiol.Chapter 84: Gasoline Degrading Bacteria (or equivalent)	Bioremediation Potential
CENSUS DNA Analysis - Aerobes/Anaerobes	Microbial Insights	Bioremediation Potential

TASK 3 - BENCH STUDY FOR IN SITU CHEMICAL OXIDATION

As discussed in the CMS (AMEC, 2013), Chemical Oxidation and Enhanced Biodegradation Recirculation was selected as a component of the preferred alternative, subject to additional characterization and pilot testing. Several oxidants are known to treat Facility-related COCs. These oxidants include persulfate, permanganate, and proprietary compounds (i.e., RegenOx® and FMC/Adventus Klozur®). Of these, activated persulfate is well suited for PCP and polyaromatic compounds (PAHs), and has been successfully used as an oxidant at sites where these compounds are associated with diesel range hydrocarbons. A bench study will assess the persulfate total oxidant demand (TOD), the effectiveness of site soil and groundwater treatment with persulfate, and provide dosing guidance for in situ applications. The testing vendor work effort, including preparation of the study report, typically is completed in 65 days from receipt of samples. The selected vendor (to be determined) will be provided a variety of different samples that are representative of the treatment area.

Oxidant treatability testing services will include:

1. Measuring the persulfate TOD in the test soil. The TOD testing will entail mixing of the soil/groundwater slurry with activated sodium persulfate at three dosages, with measurement of the TOD at varying times (48 and 96 hours are typical) post treatment. Sodium persulfate will be base activated with sodium hydroxide to a pH of greater than 10. Information from TOD testing will be used to set the dosage levels for effectiveness testing.
2. Conducting effectiveness testing to measure the contaminant reduction in soil and groundwater after treatment. A soil/groundwater slurry sample will be treated with base activated sodium persulfate and iron activated sodium persulfate at two dosages levels (low and high) set based on data collected in TOD testing. Control and treated samples typically would be allowed to react for 28 days. Water from the control and treated samples would typically be measured for chlorophenols and TPH at 14 days. The soil and water fraction would typically be measured for chlorophenols and TPH at 28 days. The water fraction will be separated from the soil fraction and the respective fractions will be analyzed separately.
3. Measuring secondary parameters in samples, including residual persulfate, selected metals, oxidation-reduction potential (ORP), and pH. The secondary parameters will be measured in the liquid phase of treatment samples during the study, typically at 14 and 28 days post oxidant addition.

A soil quantity of approximately 2,000 grams per sample is required for TOD and effectiveness testing. Soil samples should be collected in acetate liners from the area of contamination. If liner collection cannot be achieved, samples should be collected in wide mouth glass soil jars with no headspace. In addition, approximately 5 liters of groundwater is also required for each sample.

Groundwater should be collected in wide mouth glass bottles with no headspace. All samples will be placed in coolers with ice, and handled under chain of custody in accordance with the SADMP.

In addition to the above described bench test, soil and groundwater samples may be provided to vendors for independent assessment (i.e., Regenesis, FMC/Adventus). All results from the bench tests and vendor assessments will be provided in the summary report developed in Task 5.

TASK 4 - EVALUATION OF BENCH SCALE DATA AND DESIGN OF PILOT TEST

Task 4 includes preparation of a report summarizing all field and laboratory activities and bench test results. In addition, the report will include a design for a pilot test to be performed at the Facility based on the data generated in Tasks 1 through 3. The pilot test design discussion will include oxidant type, dosing parameters, delivery system, location(s) of oxidant injection and groundwater extraction (if relevant), effectiveness monitoring parameters, and a schedule. The report will be submitted to EPA for review.

TASK 5 - PILOT STUDY FOR IN SITU CHEMICAL OXIDATION

Based on the results of Task 4 and pending EPA approval, a field-scale pilot study will be conducted to confirm ISCO effectiveness under field conditions and to develop chemical and hydraulic performance data to use in completing the remedial design. Field testing will involve injection, extraction, and sampling and analysis of nearby monitoring wells, or installing boreholes and collecting soil samples, depending on the design of the pilot test.

The pilot study would be performed in an upgradient part of the source area so that groundwater migration does not recontaminate the area during testing. The pilot study area would be appropriately sized relative to scale of the treatment system so that the full effects of treatment (injection, extraction, circulation, and reaction) can be monitored with reasonable precision.

The actual location and/or size of the pilot study area may be modified depending on the results of Tasks 1 through 4, and on the operational needs of the Facility. The pilot study will be designed to not spread contamination, and chemical conditions in the aquifer will revert to pre-test conditions over the long-term.

The pilot study will be conducted to validate and/or refine the ISCO design assumptions, including radius of influence, oxidant dosage rates, oxidant infiltration rates, and oxidant application rates. One or more injections of the oxidant are planned, and the injection, extraction, circulation, and reaction of the oxidant will be monitored.

PROPOSED SCHEDULE

Tasks 1 and 2 field activities can be initiated within 30 days of authorization to proceed from EPA, pending contractor availability and access from Stella-Jones Corporation. Field work is anticipated to be completed within one week, and bench testing and laboratory analysis is anticipated to require an additional 65 to 70 days. The evaluation of field and bench test data, along with a pilot test design, is anticipated to be completed approximately 120 days from initiation of field activities. The schedule for the pilot test (Task 5) will be presented the Task 4 evaluation report. Pertinent information from field and laboratory activities will also be included in the monthly progress reports submitted to EPA.

CLOSING

If this Work Plan meets with EPA's approval, please provide written authorization to proceed. Baxter plans to initiate the scope of work outlined in this Work Plan within 30 days of receipt of approval from EPA, pending contractor availability and access from Stella-Jones Corporation. If you have any additional questions or comments, please do not hesitate to contact Steve Barnett at (503) 639-3400.

AMEC Environment & Infrastructure, Inc.	**Reviewed By:**
J Stephen Barnett, L.G. Senior Geologist	Patrick Hsieh, P.E. Senior Engineer

Attachments: Figures 1-3

SB/cw

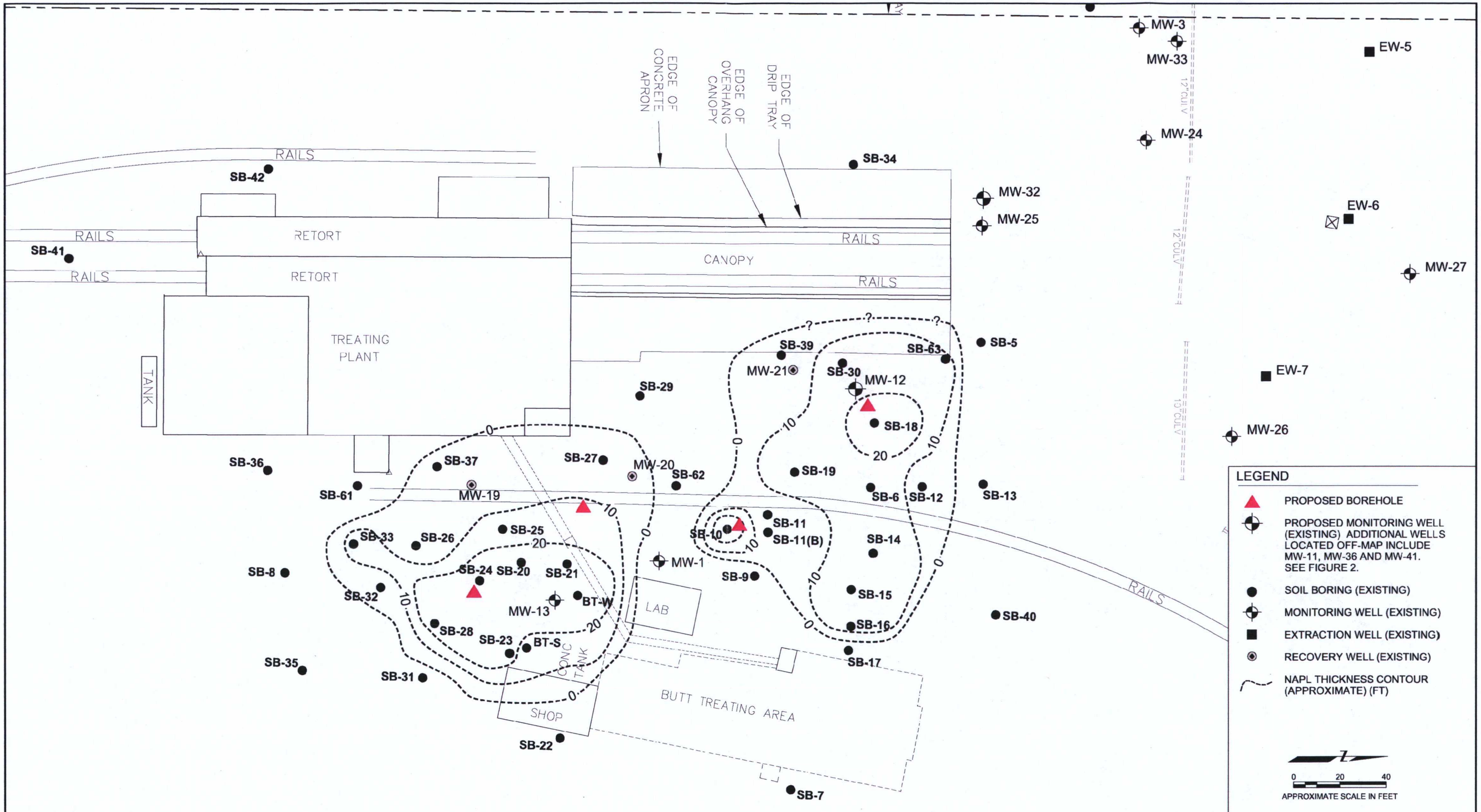
c: Georgia Baxter, J.H. Baxter & Co.
RueAnn Thomas, Nattura Group

REFERENCES

Baxter, 2002. Site Investigation Work Plan, Revision 2. J.H. Baxter & Co. Wood Treating Facility, Arlington, Washington. Prepared for EPA Region 10 by the J.H. Baxter Project Team. May 15.

Baxter, 2005, Site Investigation Report, J.H. Baxter & Co., Wood Treating Facility, Arlington, Washington: Prepared by the Baxter Project Team, April 14, 2005.

AMEC, 2013, Corrective Measures Study Revision 3, J.H. Baxter & Co. Wood Treating Facility, Arlington, Washington: Prepared by Baxter Project Team, April 2013.



CLIENT: J.H. BAXTER	DWN BY: JRS	PROJECT: FORMER J.H. BAXTER AND CO. WOOD TREATING FACILITY ARLINGTON, WA	DATE: JUNE 2013
	CHK'D BY: SB		PROJECT NO: 3-61M-125611
AMEC 7376 S.W. Durham Road Portland, OR. U.S.A. 97224	DATUM: -	TITLE: PROPOSED BOREHOLE AND GROUNDWATER MONITORING LOCATIONS	REV. NO.: A
	PROJECTION: -		FIGURE No. 3
	SCALE: AS SHOWN		

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Fuentes, Rene

From: Fuentes, Rene
Sent: Tuesday, July 23, 2013 10:10 AM
To: Jan Palumbo
Cc: Fleming, Sheila
Subject: J H Baxter Chem Ox Pilot Test Work Plan

Jan,
The general concepts on the plan seem reasonable. The level of specificity and detail seem to be lacking. If we had documented evidence that the facility and consultants had done this type of work successfully before it may be more reassuring, but at this point it seems that we need many more details in a number of topics. Here are some bullets with topics which I think need to be covered (at a minimum):

- *Need a QAPP for the work details.*
- *Sampling for the soil and water needs an SOP which is related to Chemical Oxidation work needs.*
- *Where will the test be done and by whom. Previous experience on this type of work?*
- *Statement that in addition to work may provide soil and groundwater for independent assessment. What would be the criteria for that?*
- *The results "will be provided in the report in Task 5"? That happens to be the Pilot Study, and we need the data from bench study prior to that to determine whether to move to pilot study.*
- *Schedule of work is missing.*

This may not be all the issues that I find on this plan, but it does give an indication of what I think are deficiencies that we need to discuss with the facility.

René

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